witnesses, the patient awoke and saw his tooth lying on the floor. The next day the Boston *Journal* stated: "Last evening, as we were informed by a gentleman who witnessed the operation, an ulcerated tooth was extracted from the mouth of an individual without giving him the slightest pain. He was put into a kind of sleep by inhaling a preparation, the effects of which lasted about three-quarters of a minute, just long enough to extract the tooth."

The enthusiasm of Doctor Morton over his discovery was boundless. He entirely neglected his dental practice and devoted all of his time to experimenting with what he had found, and in devising an inhaler for its use.

On the morning of October 16, 1846, the operating room of the Massachusetts General Hospital was filled with members of the staff of the hospital who had assembled to witness the success or failure of Doctor Morton in demonstrating his wonderful discovery. The operation—removal of a tumor of the jaw by Dr. John Collins Warren—was scheduled for ten o'clock. At ten o'clock Doctor Morton had not appeared and, after waiting some minutes longer, Doctor Warren decided to go ahead with the operation without him. Just then Doctor Morton arrived with an apology that he waited for the completion of his inhaler. The scene was now laid for one of the most far-reaching events in the history of medicine. As the operation progressed a hush fell upon those present, followed by a period of absolute silence. The struggles and agonizing screams which had attended previous surgical operations were absent. The patient showed no sign of pain. The operation completed, Doctor Warren turned to the physicians present and said, "Gentlemen, this is no humbug."

The room in which this historic event took place is still preserved, and the sixteenth of October is celebrated each year as "Ether Day."

The first notice to the medical profession of Doctor Morton's discovery appeared in the *Boston Medical and Surgical Journal,* October 21, 1846, and reads as follows:

Strange stories are related in the papers of a wonderful preparation, in this city, by administering which, a patient is affected just long enough and just powerfully enough, to undergo a surgical operation without pain.

"The greatest gift of medical science to humanity" was without a name. It was called:

Doctor Morton's discovery; Doctor Morton's preparation; etherism, ether inhalation, ethereal inhalation; insensibility in persons requiring surgical operations; letheon and may other terms and phrases.

The name finally decided upon is stated in the following letter to Doctor Morton from Dr. Oliver Wendell Holmes:

Boston, November 21, 1846. My dear Sir: Everybody wants to have a hand in a great discovery. All I will do is to give you a hint or two, as to names, or a name to be applied to the state produced and the agent.

The state should, I think, be called anesthesia. This signifies insensibility, more particularly (as used by Linnaeus and Cullen) to objects of touch. (See Good, Nosology, p. 259.) The adjective will be anesthetic. Thus, we might say, the state of anesthesia, or the anesthetic state. I would have a name pretty soon, and consult some accomplished scholar such as President Everett or Doctor Bigelow, Sr., before fixing upon the term, which will be repeated by the tongue of every civilized race of mankind. You will mention these words which I suggest for their consideration, but there may be others more appropriate and agreeable. Yours respectfully, O. W. Holmes.

The word "anesthesia" which Doctor Holmes thus suggested was not immediately accepted, but it was finally adopted.

Despite the comparatively slow means of communication of the time, the rapidity with which Doctor Morton's discovery became known, and was put in use, is without parallel in the history of medicine. The news was spread through the daily papers, medical journals, and by personal letters. Thus:

On October 16, 1846 occurred the first public successful ether anesthesia.

On December 15, 1846, ether was administered in Paris.

On December 18, 1846, ether was administered in London.

So that six months after this discovery, inhalation anesthesia was known and practiced throughout the civilized world.

The prediction of Doctor Holmes that the term "anesthesia" would be "repeated by the tongue of every civilized race of mankind" has been absolutely justified.

1020 Union Street.

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MICROSCOPICAL EQUIPMENT—COMMENTS ON CHOICE AND USE OF INSTRUMENTS*

NOTES ON THE SELECTION OF A MICROSCOPICAL EQUIPMENT

By WILLIAM M. JAMES, M. D.
Panama, R. P.

THE microscope of today, with its accessories, when produced by a reputable maker, is an instrument of precision and perfect in its parts. The testing of lenses, fascinating and useful as this is, no longer need be a necessity for the purchaser. The stands and movements are durable and exact in workmanship. Indeed, about the only factor which causes trouble is lack of knowledge of how to use the instrument, and a comprehension of what it can and cannot do.

More and more today there is a tendency on the part of physicians to leave the work of the microscope to their technicians and other laboratory assistants. Most of these and, indeed, many physicians themselves, have learned the use of the microscope by rule of thumb. It is true that stained histological and pathological sections do

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not require any special skill in microscopy for their study, but when working with fresh and unstained material and with the dark field, some elementary knowledge of the art is essential if good results are to be obtained, especially with reference to illumination. Most amateurs work with magnifications which are entirely too high and illumination which is not sufficiently strong.

STAND

The selection of a stand depends entirely on the use to which it will be put. If the instrument is to serve for both laboratory and field work, one of the modern portable stands should be chosen. This may be equipped with a mechanical stage, triple nosepiece, and a good condenser, and so equipped, will handle any but the most critical work, while its portability has an advantage appreciated only by those who have tried to transport the usual type of stand through difficult places. The substage can be fitted also with a dark-field illuminator, and a binocular attachment can be provided for base laboratory use. If I could have only one microscope, I should certainly select a stand of this type, whether for use in the laboratory or in the field.

If the stand is for use in a base laboratory it is always wise to select one of the better models. This should be equipped with interchangeable monocular and binocular tubes. For use in the tropics, the undetachable binocular should not be considered. While the binocular is coming more and more into favor, and justly so, in damp climates a certain amount of mould accumulates on the prisms, and some types of binocular tube must be returned to the makers for cleaning, during which time, or in case of accident to the binocular arrangement, the monocular tube may be substituted. In Panama I find it necessary to return one of my binocular tubes about every six months, and so I keep an extra one at the agent's, and notify him when to forward it to me. There is, however, no reason why these tubes should not be made so the prisms may be cleaned as readily as eyepieces, and I believe one of the British manufacturers does make such a tube.

ACCESSORIES

Where protracted work must be accomplished, such, for instance, as looking through a large number of stools or thick films in surveys, the saving of eyestrain by the binocular is worth all of its extra cost. Nor is there any loss in definition, as some urge. For some years I have made careful comparisons between the binocular and monocular tubes on the most difficult test objects, and the resolution and definition with the former are in every way equal to that of the latter, and in some respects they are better, particularly in low-power work. There is a perceptible loss of light with the binocular, especially with the higher powers, but this is readily compensated by increasing the intensity of the illumination, and seldom is noticed except in working with immersion lenses and high-power eyepieces.

One great fault in the leading makes of American and Continental stands is the lack of a centering apparatus for the substage, except in expensive research models or when especially ordered. This should not be. In the lower-priced British models there are adequate facilities for centering the condenser and other substage accessories, and such facilities should be insisted upon by purchasers of even the simpler types of stand. More than one poor performance is due simply to dark- or light-field condensers being off center.

The dark field is coming more and more into daily use for practical purposes. The dark-field condenser should be easily attached, centered and removed, and there is no excuse today for the elaborate and clumsy models supplied by some makers. Nor is there any need for a special stand and illuminator devoted solely to dark-field work. On three of my stands the condensers can be readily changed in a few minutes. Two of these stands are expensive research models, but the third is a moderately priced Continental stand, and serves equally as well for this purpose as do those higher priced. If research work is to be considered, the substage should be arranged for oblique illumination, and in any case it should be provided with a rack and pinion, an iris diaphragm, and a stop carrier. If insisted upon, all of these can be provided for in the larger portable models.

OBJECTIVES AND EYEPIECES

It is a prevalent, but much mistaken conception among many users of the microscope that the higher the magnification the easier it is to see fine detail. As a rule total magnification is obtained by multiplying the initial magnification of the objective by that of the eyepiece at a given tube length. Magnification is often confused with resolution, which is that quality of the objective by which detail is defined. In a limited contribution such as this I cannot discuss the subject, but it is generally explained in the makers' catalogues or in the instruction books which should accompany each microscope when sold. The difference between magnification and resolution must be thoroughly understood if one is to have the barest grasp of the essentials of microscopy. Suffice it to say that no amount of magnification will show detail that has not first been resolved, although it may show it more clearly, and frequently does so, when resolution has been effected. Resolution depends upon the numerical aperture (N. A.) of the objective, and is in direct proportion to it, so that, other conditions being equal, an objective of 0.60 N. A. will resolve twice as many lines to the inch as will one of 0.30 N. A. Roughly speaking, with proper illumination by direct white light and the iris diaphragm contracted to two-thirds of the margin of the field of the back lens, a good objective will resolve about its N. A. x 70,000 lines to the inch, and with oblique white light, about its N. A. x 95,000. This latter is rarely used in medical and biological work, and for most purposes it will serve to calculate in values of N. A. x 70,000 in determining the resolution desired. Total magnification should not be carried further than the

N. A. x 1000, and for routine work the N. A. x 500 is amply sufficient.

The standard set of objectives is generally composed of what are called the low dry power, two-thirds, or 16 mm; the high dry, one-sixth, or 4 mm; and the one-twelfth, oil immersion, or 1.9-2 mm. With these are furnished two eyepieces, with magnifications of 5x and 10x respectively. These give total magnifications of from 50 to 900, and resolution of from 18,000 to between 87,500 and 93,000 lines per inch, amply sufficient for all practical needs.

For use in laboratory work, however, I should like to suggest some other combinations. Several writers, particularly the late Doctor Spitta, Mr. Conrad Beck and Doctor Coles, have also outlined similar combinations. The 16 mm. or two-thirds, is too high a power for survey work in looking for helminth infections. Nearly all, if not all, helminth eggs can be plainly seen with a 24 mm., or one-inch objective, or even with a 32 mm. objective and a 5x eyepiece. With such combinations, the field is considerably larger, and much time is saved. With a 10x or 15x eyepiece, detail may be clearly seen. These combinations are also very useful in orienting tissue sections. They should be used without a substage condenser, and with the concave mirror.

An extremely useful lens, and one but little appreciated except by experts, is the 8 mm., or one-third. This has an initial magnification of 20, and an N. A. of from 0.60 to 0.65. The latter should be obtained whenever possible, but has the disadvantage of coming mostly in the apochromatic series, and so necessitating the use of the more expensive compensating eyepieces. But so used, the results are most satisfactory. With a low-power eyepiece, it will do the work of a 16 mm. objective, and with eyepieces of 10x and 15x, it will show as much as will the ordinary 4 mm., or one-sixth. Its N. A. is as high as that obtained in practice with a 4 mm. of 0.85 N. A., since this latter objective can be rarely used at full aperture. With a properly cut stop in the substage stop carrier and suitable illumination, it gives with a good condenser an excellent dark field, without the necessity of changing condensers. With such a combination, even by using a 5x eyepiece, spirochetae can be found in fluids, and with eyepieces from 10x to 15x, their detail can be made out clearly. In these days, fresh preparations are rarely used in the diagnosis of malaria, but the parasites are more readily found in fresh preparations by the dark field than otherwise, and an 8 mm. objective of 0.60 N. A. or more with a 10x or 15x eyepiece picks them up very nicely.

But whatever may be thought of the use of the combinations above suggested, I am convinced that the 3 mm., or one-tenth oil immersion objective, is much more useful in every way than the usually supplied 1.9-2 mm., or one-twelfth. It has an initial magnification of about 72, and an N. A. of 1.30, which is ample for the most critical work in medicine or biology. The fluorite objective of this type costs but little more than the achromatic and will stand an eyepiece of 20x or even 25x, and it takes an expert working with specially selected test objects to distinguish its performance from that of the apochromatic, except in photography. And it will work through the thickest No. 2 cover glasses, a great advantage. With a 10x eyepiece, one can see practically all there is to be seen. It should be purchased with a funnel stop, so that it can be used for high power dark-field work, although this reduces the resolution, and there is a better combination for such work, as will be presently pointed out. In the apochromatic type, with a 1.40 N. A., it is preferred by most experts to the 2 mm. of the same aperture, on account of its greater stability and longer working distance.

Another extremely useful but little known objective is the one-seventh, or 3.5-4 mm. oil immersion. This has an initial magnifying power of about 55, and the fluorite type will stand an eyepiece of 25x. Its N. A. is 0.95, and it can be used without funnel stops in dark-field work, where its performance is decidedly superior to the higher powered oil immersion lenses whose apertures have been cut down by funnel stops or otherwise. With blood films and other stained smears, it will show practically all that is necessary, and its relatively large field is very useful in searching and in survey work. It should be remembered that when the condenser is not joined to the slide with immersion oil, no objective, no matter how high its N. A., will give a working N. A. of more than 1. For several years I have used a lens of this type almost exclusively in my routine work on stained smears, reserving my higher powers for special uses. This lens is being made today with an iris diaphragm between its components. It has a full aperture of 1.01, and with a slight turn of the diaphragm can be used for dark-field work.

The high dry, one-sixth or 4 mm. objective, usually supplied, has an N. A. of 0.85. This is too high for routine work, either with fresh or stained preparations. At full aperture the glare obscures the object, and the iris diaphragm has to be closed until the N. A. is reduced to about 0.60. Obviously there is no advantage in this, and today most makers supply what is called a histological one-sixth with 0.65 N. A. corrected especially for use with stained specimens. This objective has a long working distance, and considerably more of what is called depth of penetration than has the 0.85. Theoretically this type of lens is condemned by experts and in most books on microscopy, but practically it is an extremely useful objective and, except for slight color fringes, works equally as well with fresh material. Even with diatoms, it will give excellent performances, while with stained material, such as tissue sections, its work is admirable. The 0.85 4 mm. objective is very susceptible to variations in cover glass thickness and will not perform well unless adjusted to the thickness for which it was originally corrected, and requires special illumination. This is seen particularly when working with fresh material.

The cost of fluorite objectives, as noted, is but slightly more than that of achromatics, and the fluorite type should be selected when possible, especially when there is much fresh material to be examined, and where the dark field is used routinely. With a color screen they do admirably in photography as well, and they are very durable. Apochromatic objectives are all that is claimed for them, but they are a luxury, and not a necessity.

ILLUMINATION

Few users of the microscope recognize the importance of proper illumination. Any source of light that will show them their material is regarded as suitable.

The selection of a proper illuminant depends entirely upon the class of work to be done. My personal experience is that most trouble comes when the source of light is not properly managed. Light from the usual electric-light bulb, even when frosted, is not suitable without modification. A thin piece of Corning daylight glass, ground on one side, will give admirable results, especially if the condenser is racked down somewhat.

The best sources of light, such as Pointolite, and the Tungsten band filament, require special lamps, and rheostats or transformers, and must be centered and adjusted very accurately. They do indeed give most admirable performances, and a very bright source of light is highly desirable, but they are clumsy and cannot be transported easily, and for most purposes the ordinary incandescent bulb must be used. This should be frosted, of course, and placed in a box which will exclude light from the eye of the worker.

Oil lamps are not produced by American makers or used today where electricity can be obtained, but in places where the electric supply is doubtful or uncertain, a well-made oil lamp will give all the light that is necessary, and is preferred by more than one expert for all purposes. They should be specially constructed, and can be obtained from the British makers. They should be equipped with a good bull's-eye, and be freely adjustable in every direction. The ordinary table lamp can be used in an emergency, but it does not give a good light for working.

The personal equation enters largely into the problem of the intensity of illumination, but as a general rule it may be said that the untrained microscopist uses too weak a light. Most of the small substage lamps are unsuitable, and the glasses, daylight or otherwise, supplied with them are entirely too thick. The Bausch and Lomb Optical Company supply a very thin daylight glass, cut to fit the substage stop carrier, and I have found this the most useful all-around light filter.

The condensers usually supplied with the moderately priced stand are of the uncorrected Abbe type. They do very well for ordinary illuminating purposes, but cannot be used with a substage stop to make a dark field for low powers. The achromatic condenser of 1.30 N. A. costs but very little more, and should be substituted. As above noted, the substage should be so arranged that the light-field condenser can be easily removed, and a proper centering apparatus is highly desirable.

At this time combination light- and dark-field condensers can be obtained. With a little practice these work very well, and will be found extremely useful.

SUMMARY

1. For combination field and laboratory work one of the larger portable stands is recommended. However, in purchasing such a stand it should be insisted upon that the substage is made so that accessories can be readily interchanged, and a swing-out stop carrier should be provided also. A binocular attachment will be found of great service, but it should be interchangeable, and not attached permanently to the stand.

2. The standard set of objectives, that is, the two-thirds, one-sixth and one-twelfth, will serve all practical purposes. At the same time it is recommended that the one-tenth fluorite oil immersion be substituted for the one-twelfth. The consideration of the other objectives above referred to is also recommended. Their cost is not great, and they will be found highly useful. The achromatic condenser should be substituted for the ordinary Abbe.

3. The dark-field condenser should be easily and readily interchangeable. And the combination dark- and light-field condenser will be found highly useful, although this should not be used exclusively in place of the achromatic condenser.

4. The use of a thin piece of daylight glass, ground on one side to modify the source of light, is recommended. This should not be too thick. The source of light should be intense rather than weak, modified suitably by proper light filters.

The Herrick Clinic.

PEPTIC ULCER—WITH AN ANALYSIS OF ONE HUNDRED CONSECUTIVE CASES*

By James Anthony Guilfoil, M. D.
San Francisco

Discussion *by Wallace I. Terry, M. D., San Francisco; Walter B. Coffey, M. D., San Francisco.*

THERE is probably not another hospital on the Pacific Coast where so many cases of peptic ulcer are to be seen as in the Southern Pacific General Hospital in San Francisco. Our patients come from seven states; they have been through the hands of the company physicians in their home towns; and finally on account of the chronicity of their digestive disorders, have been sent to the central hospital for diagnosis and treatment.

CASES IN THIS HOSPITAL

It may interest you to know that in February, 1925, we had at one time in the gastro-intestinal ward, eleven cases of gastric and duodenal ulcer, nine of whom were actively bleeding. Starting with Christmas day, 1923, and running to Feb-

* From the Section on Gastro-Enterology, Southern Pacific Hospital, San Francisco.

* Read before the staff of the Southern Pacific Hospital, San Francisco, December 7, 1927.